REMARKS

Amendments

Claims 1, 11, and 17 have been amended to clarify that the process applies to a feed-gas mixture comprising a *heavy* hydrocarbon fuel. Support for these amendments is found throughout the Specification, including at paragraphs [0017]-[0018], [0026], and [0033]. Claim 7 was cancelled and claims 8, 15, 19-21, and 25-26 have been amended to eliminate redundancy in claiming use of a heavy hydrocarbon fuel in the feed gas mixture.

Claim 1 has been amended to clarify that the feed gas mixture is maintained below about 300°C with the heavy hydrocarbon fuel having a temperature in the range of about 150°C to about 240°C. Claim 17 also was amended to reflect that the feed gas mixture is maintained below about 300°C. Support for these amendments may be found through the Specification, including at paragraphs [0034], [0047], and original claim 6.

Claims 1 and 17 also have been amended to add the limitation that the cooling of the pre-reaction zone adjacent the catalytic reaction zone is done with fins and/or heat exchangers. Claim 4 has been deleted. Support for these amendments is found throughout the Specification, including at paragraphs [0027] and [0047].

Upon entry of the foregoing amendments, claims 1-3 and 8-28 are pending. Reconsideration of the present application, as amended, and allowance of the pending claims is respectfully requested in view of the following remarks.

Rejection Under 35 U.S.C. § 112

The Examiner has rejected claims 1-10 under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. Applicants respectfully traverse the rejection as moot in light of the claim amendments.

Rejection Under 35 U.S.C. § 103

The Examiner rejected claims 1 and 7-10 under 35 U.S.C. § 103(a) as being obvious over U.S. Patent 6,221,280 to Anumakonda et al. (hereinafter "Anumakonda") in view of Dicks, *Journal of Power Sources*, vol. 61, pg 113-124 (hereinafter "Dicks"). The Examiner rejected claims 2-4 as being unpatentable over Anumakonda in view of Dicks and U.S. Patent 5,567,228 to Abdulally (hereinafter "Abdulally"). The Examiner rejected claims 11-16 as being unpatentable over Anumakonda in view of U.S. Patent 4,331,451 to Isogaya et al. (hereinafter "Isogaya") and U.S. Patent 6,103,143 to Sircar et al. (hereinafter "Sircar"). The Examiner rejected claims 17-28 as being unpatentable over Anumakonda in view of Dicks, Isogaya, and Sircar. Applicants respectfully traverse these rejections.

Anumakonda In Combination with Dicks

The combination of Anumakonda and Dicks fails to teach or suggest the desirability of a *pre-reaction zone upstream of the catalytic reaction zone*. More particularly, neither Anumakonda nor Dicks, alone or in combination, teaches or suggests that *cooling the pre-reaction zone* to maintain the temperature of the feed gas mixture below the flash point *reduces the premature reaction of the fuelgas mixture*.

Contrary to the Examiner's suggestion, the previously shared endpoint between the claimed temperature range and Dicks does not provide the same advantages that result from Applicants' claimed invention. While Applicants' pre-reaction zone does not *expressly* exclude the possibility of a pre-reaction zone comprising a pre-reforming zone, the limitation requiring the reduced temperature to *reduce the premature reaction of the fuelgas mixture in the pre-reaction zone* inherently excludes the possibility of a pre-reaction zone comprising a pre-

reforming zone. Specifically, pre-reforming can not take place in the Applicants' pre-reaction zone because to do so would result in the *premature reaction of the fuelgas mixture*.

Applicants' respectfully submit that the suggestion that reducing the temperature of the feed in the pre-reaction zone would reduce premature reaction in the pre-reaction zone does not flow naturally from the teaching of Dicks. As Applicants have previously explained, Dicks teaches the desirability of pre-reforming heavier hydrocarbons present in the feed stream *prior* to feeding the gas to the main reactor in order to remove the C_2 + hydrocarbons before the gas is fed to the main reformer (Pg. 117, N[8] and accompanying text). Applicants, conversely, require that the heavy hydrocarbons be fed directly to the main reformer. Moreover, Applicants also require that the pre-reaction zone adjacent the catalytic reaction zone be cooled with fins and/or heat exchangers to maintain the temperature of the feed gas mixture below the flash point of the heavy hydrocarbon feed gas mixture until the feed gas mixture enters the catalytic reaction zone.

Applicants respectfully submit that it would not be obvious to one of ordinary skill in the art to cool the pre-reaction zone with fins and/or a heat exchanger in order to reduce the temperature and premature reaction of the heavy hydrocarbons in the pre-reaction zone, because doing so would directly contradict the teachings of the prior art references. Specifically, one of ordinary skill in the art would not be inclined to cool the pre-reforming zone of Dicks using fins and/or a heat exchanger, because doing so would impede the pre-reforming process, which requires heat for initiation of the reaction and also results in the production of heat from the reduction of the heavy hydrocarbons.

Anumakonda In Combination with Dicks and Abdulally

As described above, the combination of Anumakonda and Dicks does not remotely teach or suggest the desirability of cooling a pre-reaction zone upstream of the catalytic reaction zone

to reduce the premature reaction of the fuelgas mixture. The combination of Abdulally with Anumakonda and Dicks does not supplement the deficiencies of the combination of Anumakonda and Dicks. On the contrary, neither Anumakonda, Dicks, nor Abdulally, alone or in combination, make any teaching or suggestion of the desirability of cooling a *pre-reaction zone* with fins and/or a heat exchanger upstream of a catalytic reaction zone to *reduce the premature reaction* of a feed gas mixture in the pre-reaction zone. On the contrary, as Applicants have described above, one of ordinary skill in the art would not use fins or a heat exchanger to cool a pre-reaction zone in order to avoid a premature reaction because doing so directly contradicts Dicks' teaching of the desirability of pre-reforming heavy hydrocarbons.

Anumakonda In Combination with Isogaya and Sircar

Anumakonda, Isogaya, and Sircar, alone or in combination, fail to teach or suggest a *post-reaction zone maintained at a temperature greater than about 600°C*, as required by Applicants' independent claims 11 and 17. More particularly, none of the references teach or suggest the desirability of *maintaining* the temperature of the exit gas *after* leaving the reaction zone until the conversion of the feed gas mixture to hydrogen and carbon monoxide is substantially entirely complete.

For example, Isogaya teaches only that the product gas has a temperature of from 800°C to 1100°C *upon exiting the catalyst bed* and before the product gas is discharged from the reaction zone. Isogaya makes no teaching or suggestion that it would be desirable to *maintain* a higher temperature after exiting the reaction zone. See, e.g., Col. 13, Lines 55-58.

Applicants also disagree with the Examiner's assertion that Sircar's teaching of a increasing temperature gradient in the reactor itself would be sufficient to teach one of ordinary skill in the art the desirability of maintaining the temperature of the gas *after* exiting the catalyst

bed. As Applicants have previously explained, Sircar teaches that an increasing temperature *along the length of the catalyst bed* within the reactor may be beneficial to drive the reaction to completion *before* the gas exits the catalyst bed. See, e.g., Col. 9, Lines 36-50 and Col. 10, Lines 6-10. Sircar would not suggest to one of ordinary skill in the art that the temperature should be maintained *after* exiting the catalyst bed. Thus, neither Isogaya nor Sircar remotely teach or suggest that the product gas temperature should be *maintained* at a particular temperature *after exiting* the reaction zone.

Anumakonda In Combination with Dicks, Isogaya, and Sircar

Applicants' respectfully refer the Examiner to the arguments made hereinabove distinguishing the Applicants' claimed invention from the combination of Anumakonda and Dicks and the combination of Anumakonda, Isogaya, and Sircar.

The rejections are unsupported by the prior art and must be withdrawn, as a case of *prima facie* obviousness clearly is lacking.

Conclusions

For the foregoing reasons, Applicants submit that claims 1-3 and 8-28 are novel and nonobvious in view of the prior art. Allowance of the pending claims is therefore earnestly solicited.

If there are any issues which can be resolved by a telephone conference or an examiner's amendment, the Examiner is invited to telephone the attorney at (404) 853-8012.

Respectfully submitted,

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